## CLAIMS

1. A method of incorporating a mark of origin or fingerprint in a CVD single crystal diamond material, which includes the steps of providing a diamond substrate, providing a source gas, dissociating the source gas thereby allowing homoepitaxial diamond growth, and introducing in a controlled manner one or more chemical dopants into the synthesis process in order to produce the mark of origin or fingerprint in the synthetic diamond material, which dopant is selected such that the mark of origin or fingerprint is not readily detectable or does not affect the perceived quality of the diamond material under normal viewing conditions, but which mark of origin or fingerprint is detectable or rendered detectable under specialised viewing conditions.

2. A method according to claim 1, wherein the mark of origin or fingerprint is detectable or rendered detectable when the diamond material is exposed to light or radiation of a specified wavelength.

3. A method according to claim 1 or claim 2, wherein the mark of origin or fingerprint is provided in the form of one or more layers or regions grown into the diamond material during synthesis.

4. A method according to any one of the preceding claims, wherein the one or more chemical dopants introduced into the synthesis process are added in a gaseous form.

5. A method according to any one of the preceding claims, wherein the chemical dopant, or one of the dopants, provides a source of nitrogen which is incorporated into the diamond, and which produces a mark of origin or fingerprint that shows 575 nm and/or 637 nm luminescence peaks, with their associated vibronic systems, under suitable shorter wavelength excitation.

6. A method according to claim 5, wherein the mark of origin or fingerprint shows a photoluminescence line at 533 nm.

7. A method according to any one of claims 1 to 4, wherein the dopant or dopants provide(s) a source of boron and a source of nitrogen, which elements are incorporated into one or more specific regions of the diamond and which produce a mark of origin or fingerprint that generates characteristic phosphorescence, peaking generally in the range of 400 nm to 500 nm, under suitable shorter wavelength excitation.

8. A method according to claim 7, wherein the boron is incorporated into the synthesized diamond material in a concentration less than 0.1 ppm.

9. A method according to claim 7 or claim 8, wherein the boron is incorporated into the synthesized diamond material in a concentration greater than 0.0001 ppm.

10. A method according to any one of claims 7 to 9, wherein the concentrations of boron and nitrogen incorporated into the synthesized diamond material lie within a factor of 10 of one another.

11. A method according to any one of claim 7 to 10, wherein the boron is present in the synthesized diamond material in a higher concentration than the nitrogen.

12. A method according to any one of the preceding claims, wherein a combination of layers or regions that generate 575/637 nm luminescence and 400 nm to 500 nm phosphorescence under suitable optical wavelength excitation is grown into the diamond material during synthesis.

13. A method according to any one of the preceding claims, wherein a layer or region with a centre that emits 737 nm radiation under optical excitation is grown into the diamond material during synthesis.

14. A method according to claim 13, wherein the one or more dopants include a source of silicon.

15. A method according to claim 14, wherein the silicon is incorporated into the synthesized diamond material in a concentration less than 10 ppm.

16. A method according to claim 14 or claim 15, wherein the silicon is incorporated into the synthesized diamond material in a concentration greater than 0.0001 ppm.

17. A method according to any one of claims 1 to 12, wherein the detection of the mark of origin or fingerprint is by the human eye, in combination with other suitable optical elements including filters and lenses.

18. A method according to any one of claims 1 to 16, wherein the detection of the radiation is by an instrument providing a measure of the intensity of the radiation, or providing an indication whether this value lies above or below a threshold.

19. A method according to claim 18, wherein the radiation being detected is the 737 nm radiation.

20. A method according to any one of claims 1 to 16, wherein detection of the mark of origin or fingerprint is by optical image capture or electronic image capture, in combination with other suitable optical elements including filters and lenses.

21. A method according to any of the preceding claims, wherein the mark of origin or fingerprint in the diamond material is formed by defect centres having optical properties that are not observed in natural diamond.

22. A method according to any one of claims 1 to 20, wherein the mark of origin or fingerprint in the diamond material is formed by defect centres, the measurable or observable distribution of the defect centres being in a form not observed in natural diamond.

23. A method according to any one of claims 1 to 20, wherein the mark of origin or fingerprint in the diamond material is formed by defect centres having optical properties, the combination of the optical properties and the measurable or observable distribution of the optical centres being in a form not observed in natural diamond.

24. A method according to any one of the preceding claims, wherein the fingerprint or mark of origin provides a means by which modification to the diamond can be identified.

25. A method according to claim 24, wherein the fingerprint or mark of origin provides a means by which modification to the diamond by means of annealing can be identified.

26. A method according to any of the preceding claims, wherein the fingerprint or mark of origin is used to identify the synthetic nature of the material.

27. A method according to any of the preceding claims, wherein the fingerprint or mark of origin is used to identify the manufacturer, or as a manufacturers process identification mark.

28. A method according to any one of the preceding claims, wherein the fingerprint or mark of origin is used as or in the manner of a trademark.

29. A method according to any one of the preceding claims, wherein the substrate is a diamond substrate having a surface on which growth takes place.

30. CVD single crystal diamond material bearing a mark of origin or fingerprint in the bulk thereof, which mark of origin or fingerprint is not readily detectable or does not affect the perceived quality of the diamond material under normal viewing conditions, but which mark of origin or fingerprint is detectable or rendered detectable under specialised viewing conditions.

31. CVD single crystal diamond material according to claim 30, which is prepared, or suitable for preparation, as a gemstone.

32. CVD single crystal diamond material according to claim 30, which is prepared as a gemstone, wherein the mark of origin or fingerprint in the diamond material is formed by defect centres having properties that are not observed in natural diamond.

33. CVD single crystal diamond material according to claim 30, which is prepared as a gemstone, wherein the mark of origin or fingerprint in the diamond material is formed by defect centres, the measurable or observable distribution of the defect centres being in a form not observed in natural diamond.

34. CVD single crystal diamond material according to claim 30, which is prepared as a gemstone, wherein the mark of origin or fingerprint in the diamond material is formed by defect centres having optical properties, the combination of the optical properties and the

measurable or observable distribution of the defect centres being in a form not observed in natural diamond.

35. CVD single crystal diamond material according to claim 30, which is prepared as a gemstone, wherein the mark of origin or fingerprint in the diamond material is formed by defect centres, the distribution of the defect centres being observable as a feature through the table of the gemstone.

36. CVD single crystal diamond material according to claim 35, wherein the feature observed in the table of the gemstone is a solid geometrical shape or an unfilled geometrical shape, the precise geometry of the geometrical shape reflecting the symmetry of the gemstone about an axis passing at 90° through the table of the gemstone.

37. CVD single crystal diamond material according to claim 35 or claim 36, wherein the gemstone is of a generally round form and the feature observable in the table of the stone is a spot or a ring.

38. CVD single crystal diamond material according to claim 37, wherein the gemstone is of a round brilliant form.

39. CVD single crystal diamond material according to claim 35 or claim 36, wherein the gemstone is of a rectangular form and the feature observable in the table of the stone is a solid square or a square outline.

40. CVD single crystal diamond material according to claim 35, wherein the feature observable in the table of the gemstone is formed by one or more layers below the girdle of the gemstone lying in a plane approximately parallel with the table of the gemstone.

41. CVD single crystal diamond material according to claim 30, wherein the single crystal diamond material is prepared for an industrial application in which it is a visible element to the user, or is re-useable or needs periodic reprocessing.

42. CVD single crystal diamond material according to claim 41, wherein the single crystal diamond material is a cutting blade or a component thereof.

43. CVD single crystal diamond material according to claim 42, wherein the single crystal diamond material is a diamond scalpel blade.

44. CVD single crystal diamond material according to any one of claims 30 to 43, wherein the mark of origin or fingerprint is in the form of a single group or pattern comprising one or more marking layers, each layer having a thickness within the range of 10 µm to 1000 µm.

45. CVD single crystal diamond material according to claim 44, wherein each layer has a thickness within the range of 20 µm to 600 µm.

46. CVD single crystal diamond material according to claim 45, wherein each layer has a thickness within the range of 50 µm to 400 µm.

47. CVD single crystal diamond material according to claim 46, wherein each layer has a thickness within the range of 100 µm to 250 µm.

48. CVD single crystal diamond material according to any one of claims 30 to 43, wherein the mark of origin or fingerprint is in the form of a multiple or repeating pattern each comprising one or more marking layers, each layer having a thickness within the range 2 µm to 100 µm.

49. CVD single crystal diamond material according to claim 48, wherein each layer has a thickness within the range 5 µm to 50 µm.

50. CVD single crystal diamond material according to any one of claims 30 to 49, which, under suitable illumination conditions, exhibits orange luminescence arising from 575 nm/637 nm N related defect centres and, under or after the same or other suitable illumination conditions, exhibits blue phosphorescence associated with donor acceptor pair recombination.

51. CVD single crystal diamond material according to any one of claims 30 to 50, which, under suitable illumination conditions, exhibits more than one discrete layer in which the ratio of the thicknesses of the layers is in accordance with a pre-determined pattern.

52. CVD single crystal diamond material according to claim 30, wherein the fingerprint or mark of origin comprises one or more layers free of defects with distinguishing properties embedded in a larger volume of material, which is marked by defects with distinguishing properties.

53. CVD single crystal diamond material according to any one of claims 30 to 52, wherein the fingerprint or mark of origin is used as or in the manner of a trademark.

54. An apparatus for detecting a mark of origin or fingerprint in a CVD single crystal diamond material bearing the mark of origin or fingerprint, the apparatus comprising:

a body arranged to receive or hold CVD single crystal diamond material bearing the mark of origin or fingerprint;

a source of light or radiation arranged to direct the light or radiation at the CVD single crystal diamond material, the light or radiation being of a wavelength suitable for causing excitation of the mark of origin or fingerprint resulting in luminescence and/or

phosphorescence thereof to expose the mark of origin or fingerprint; and

a detection means for detecting the exposed mark of origin or fingerprint.

55. An apparatus according to claim 54, wherein the detection means comprises a viewer for viewing the luminescence and/or phosphorescence, or an instrument providing a measure of the intensity of the specific luminescence and/or phosphorescence.

56. An apparatus according to claim 55, wherein the measure of the intensity of the specific luminescence and/or phosphorescence is in the form of an analogue or digital electrical signal, or display readout.

57. An apparatus according to any one of claims 54 to 56, wherein the apparatus comprises a range of optical filters for viewing the wavelengths emitted by the mark of origin or fingerprint, and means for excluding background white light or wavelengths present which may be detrimental to observing the wavelengths emitted by the mark.

58. An apparatus according to any one of claims 54 to 57, further comprising magnification means for magnifying the exposed mark of origin or fingerprint in the CVD single crystal diamond material.

59. An apparatus according to claim 54, wherein the apparatus is arranged preferentially to excite 575 nm and/or 637 nm luminescence.

60. An apparatus according to claim 54, wherein the apparatus is arranged preferentially to excite blue band phosphorescence peaking in the region of 400 – 500 nm.

61. An apparatus according to claim 54, wherein the apparatus is arranged preferentially to excite 575 nm and/or 637 nm luminescence and thereafter preferentially to excite blue band phosphorescence peaking in the region of 400 –500 nm.

62. An apparatus according to claim 54, wherein the apparatus is arranged preferentially to excite the 737 nm luminescence peak.

63. An apparatus according to claim 59, further comprising one or more optical filters for enhancing detection of the 575 and/or 637 nm luminescence.

64. An apparatus according to claim 63, comprising an optical filter arranged to block the transmission of wavelengths near 450 nm, thereby to enhance viewing or detection of the 575/637 nm luminescence.

65. An apparatus according to claims 60, further comprising one or more optical filters for enhancing detection of the blue band phosphorescence peaking in the range 400 – 500 nm.

66. An apparatus according to any one of claims 59, 61, 63 or 64, wherein the source of light or radiation is selected to provide illumination in the 300 – 550 nm range.

67. An apparatus according to claim 66, wherein the source of light or radiation is a high power light emitting diode.

68. An apparatus according to any one of claims 60, 61 or 65, wherein the source of light or radiation is selected to provide illumination in the 225 - 275 nm range.

69. An apparatus according to claim 68, wherein the source of light or radiation is a pulsed Xenon source.

70. An apparatus according to claim 68 or claim 69, wherein the source of light further comprises a filter to exclude wavelengths outside the range 225-275 nm.

71. An apparatus according to any one of claims 68 to 70, wherein an observer or detector is protected from UV radiation from the source of light or radiation by the use of a window, such as a glass or Perspex window, which absorbs UV in the range 225 – 275 nm.

72. An apparatus according to claim 62, wherein the source of light or radiation is selected to provide illumination in the range 480 – 700 nm.

73. An apparatus according to claim 72, wherein the source of light or radiation is a 633 HeNe laser.

74. A method of viewing or detecting a mark of origin or fingerprint in a CVD single crystal diamond material bearing the mark of origin or fingerprint, which mark of origin or fingerprint is not visible under normal viewing conditions, the method including the steps of:

a) directing a source of light or radiation at the CVD single crystal diamond material, the light or radiation being of a wavelength suitable for causing excitation of the mark of origin or fingerprint resulting in luminescence and/or phosphorescence thereof to expose the mark of origin or fingerprint; and

b) viewing or detecting the exposed mark of origin or fingerprint.